

Identification of Driving Forces in Service Innovations: Mobile Telecommunication Industry

Completed Research Paper

Mi Ri Kim
Sogang University
mirikim@sogang.ac.kr

Jason Triche
Texas Tech University
jason.triche@ttu.edu

ABSTRACT

Innovations in services continue to be a vital topic. Compared to product innovation, service innovation has received less attention in the literature. Studying service innovation is as important as ever especially since the world economy is shifting from a manufacturing economy to a service economy. Analytical and detailed discussion about service innovations is only beginning. This study aims to contribute to service innovation field through a theoretical formulation of a research framework supplemented with findings from a qualitative approach. By studying the mobile telecommunication industry, we found that organizations may pursue a complex of service innovations that may target different type of outcomes. Our findings provide new insights that suggest the basis for new discourse on IS for service innovations.

Keywords: internal driving forces, external driving forces, service innovations, content analysis

INTRODUCTION

Innovations in services continue to be a vital topic both in industry and in research. According to a Thomson Reuters Top 100 Global Innovators report (2011 p. 133), top innovating companies added over 400,000 new jobs in 2010, a greater percent increase over 2009 than was experienced by the S&P 500. Seventy four percent of the publically traded top 100 innovating companies had an increase in stock price year over year (Thomson Reuters 2011). In today's global economic climate, service companies need to either be innovative or be quick to adopt innovation to obtain and to sustain competitive advantages.

Innovation is a broad topic which arguably can be divided into two broad areas: innovation adoption and innovativeness. Innovation adoption is the adoption of an internally generated or purchased device, system, policy, program, process, product or service that is new to the adoption organization (Daft 1982; Damanpour 1991; Damanpour et al. 1984). Innovativeness is the degree to which an individual or organization is relatively earlier in adopting an innovation than other members of his system (Rogers et al. 1971). Although there are many concepts that overlap between the two areas (Damanpour 1991), we focus our attention on innovation adoption. Research has argued that distinguishing types of innovation is necessary for understanding an organization's adoption behavior (Downs Jr et al. 1976; Knight 1967; Rowe et al. 1974).

Compared to product innovation, service innovation has received less attention in the literature. Studying service innovation is as important as ever especially since the world economy is shifting from a manufacturing economy to a service economy (Chesbrough et al. 2006). Service innovations are new developments in the core offerings of service companies that tend to create new revenue streams (Oke 2007). In some cases, these new developments can fundamentally change the way a company does business. In other cases, these new developments can result in small or incremental changes. The type of innovation that the organization undertakes determines the innovation performance of the organization (Oke 2007). Project outcomes can differ substantially depending on their innovation type (Brentani 2001). Organizations may pursue a complex of service innovations that may target different type of outcomes. These modes of developments can be categorized into six subsets of service innovation which are radical, improvement, incremental, ad hoc, recombinative, and formal (Gallouj et al. 1997).

Researchers have studied different driving forces or determinants that lead to different innovation types. Majority of this research has been in manufacturing companies and very few have studied service companies. In addition, very little empirical research exists in studying driving forces of service innovation types in service companies. We seek to fill this void in the current literature.

In this study, we seek to answer the following question. What driving forces lead to the different service innovation types? By studying service innovations in the mobile telecommunication industry, we attempt to answer this research question.

The contribution of our study is twofold. First, from a practical perspective, companies can use the framework to understand and identify the major driving forces of different service innovation types. The framework can assist companies to focus capital and energy on understanding what driving forces can influence different service innovation types. Second, from a theoretical perspective, we add to the innovation literature by identifying the factors influencing service innovations.

The article is organized as follows. In the next section, we describe prior research on innovation and develop theoretical hypotheses. The third section describes our research methods, including sampling and coding. In the fourth section, we present our results. Our final section provides a discussion of our study's findings, limitations, and implications for future research and practice.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Innovation Types in Services

While studying theoretical foundations of innovation processes in the service sector, Gallouj and Weinstein (1997) proposed six different models of innovation. They defined each innovation type by how it affected a system of characteristics and competences defined by Saviotti and Metcalfe (1984). This system of characteristics and competences include technical characteristics, resource competences, and a combination of both called final characteristics. The six different innovation types are determined depending on how the system changes and the degree of the change. The six innovation types include radical, improvement, incremental, ad hoc, recombinative, and formalization. Each innovation type will be explained below in the context of the system of technical characteristics and competences as described by Gallouj and Weinstein (1997).

Radical innovation is defined as an innovation that changes the entire system or creates a new system. This means technical characteristics, individual or group competences, and final characteristics all change. Examples of radical innovation in technology consulting could be a new product offering like in-house data storage for clients when the previous business model was only product development. Radical innovation in an insurance company could be offering new policies covering new financial instruments when previously only life and auto were covered. In both cases, the individuals and departments must adjust technical capabilities, resource competences and ultimately the organization must adapt in order to adopt and promote the new radical innovation.

Improvement innovation is where certain characteristics are improved (either technical or competences) but the structure remains the same. An example of this in a hospital could be where a new and improved narcotics tracking system is implemented but the user interface is similar to the old system so the medication aids and nurses do not need to change their competences. Improvement innovation is not widely used as an innovation type and most researchers combine it with incremental innovation but this type of innovation cannot be ignored since the cumulative nature of its effect are widely recognized (Gallouj et al. 1997).

Incremental innovation is where the general structure of technical characteristics and competences remains the same but the system is marginally changed through the addition of new elements. Incremental innovation is widely studied in innovation research and is considered along with radical innovation as two major types of innovation (Damanpour 1991). Examples of incremental innovation are commonplace through service industries. For example, in the insurance industry, different services can be added to existing policies to accommodate a customer. In hospitals, IT systems can be slightly modified to meet the specific needs of that hospital. At dry cleaners, laundry services of different items can be added without changing the technical characteristics and competences of the employees. Gallouj and Weinstein (1997) argue the difference between incremental innovation and improvement

innovation is the difference in formalizing the improvement as a new specification. Once it is formalized as a new offering, then the innovation becomes incremental in nature.

Ad hoc innovation is defined where there are significant changes in the competences and the technical characteristics (similar to radical innovation), but the innovation is not permanent. Ad hoc innovations are usually produced jointly by the service company and its customers but they are not formally recognized until after the service has been provided (Gallouj et al. 1997). An example of ad hoc innovation is where a customer service representative is attempting to help a customer that is experiencing a problem and the customer service representative creates a new, specific solution for that customer that may not be repeated (Sundbo 1997).

Recombinative innovation is defined where the technical characteristics and competences interact in different combinations than before. New innovations are created by recombining and fragmenting existing processes and technology. For example, management and technology consulting firms can combine existing practices of product development, and platform hosting into one integrative service for its customers. In this example, these two services existed previously but were supported by different parts of the organization. In this example, the firm can combine these services together to provide new service offerings with existing innovations.

The last innovation type defined by Gallouj and Weinstein (1997) is formalization. This innovation type is different than the last five and is not defined by how it affects the technology characteristics and competences. Formalization innovation is the process of making service characteristics formal and concrete. For example, a car mechanic might offer free pick up and drop off service for disabled motorist. When the car mechanic formalizes this service and makes it a part of the company's service offering, it becomes a formalization innovation.

These six innovation types, defined by Gallouj and Weinstein (1997), attempt to describe the different types of innovation in the service sector. We acknowledge there are other types of innovation including administrative/technical and product/process innovations. We adopt the six innovation types in this research based on the uniqueness of the service sector compared to the manufacturing sector.

Driving Forces

There are many driving forces that contribute to different types of innovation. This has been studied by several researchers (e.g., Brown et al. 1997; Chandy et al. 1998; Damanpour 1991; Dewar et al. 1986; Hage 1980; Katila et al. 2002; Lewin 1999; Tarafdar et al. 2007; Tellis et al. 2008). In general, driving forces can be categorized as internal and external. Internal driving forces are those forces that are internal to the organization like managerial attitudes, strategy, culture, and organizational structure. External forces are forces that are external to the organization and include competitors, market factors, and customers.

One internal driving force is internal communication. Internal communication refers to effective communications between individuals or groups in an organization (Cumming and Srivastva 1977). Internal communication also refers to how an organization structuralizes internal resources including individuals' knowledge related core competencies. Internal communication includes exchanging information or knowledge among employees as well as communication between executives and employees in the hierarchy of an organization. Dewar and Dutton (1986) found that the degree of knowledge depth is important for the adoption of innovations.

Another internal driving force is organizational absorptive capacity. The main driver to lead innovation is the ability to absorb and implement knowledge from environments (Cohen and Levinthal 1990). In this study, we define organizational absorptive capacity as capabilities of recognizing knowledge and values from external environments.

Organizational research and development (R&D) resources are equally important to organizational strategy since the resources become critical factors in any innovation process. Therefore, the resources should be valuable, rare, inimitable, and non-substitutable in order to implement new innovations (Cohen and Levinthal 1990). The core competency for an organization's R&D department is the organizational knowledge and skill sets of the employees. An organization's R&D department should play a major role in creating dedicated innovations for the organization.

Furthermore, managerial attitude towards innovation plays an important role in driving innovations (Kaluzny et al. 1974). Many previous studies have proven that an active mind set from managers determines the success of innovation processes (Matting et al. 2004; Nonaka and Takeuchi 1995; den Hertog 2000).

The internal part of the organization is a major driving force to service innovation. Internal communication is the life blood of an organization and has been shown to positively affect the adoption of innovation (Dewar and Dutton 1986). Since service innovation shares the same basic characteristics as manufacturing innovation, we posit that internal communications will positively affect service innovations. Second, an organizational absorptive capacity allows a company to recognize and inherit knowledge from the external environment. Service innovation thrives when companies can adapt and incorporate feedback. Therefore, we posit that organizational absorptive capacity positively affects service innovation. Third, by definition an organization's R&D team plays a vital role in creating innovation. Therefore, we posit that an organization's R&D team positively affects service innovation. Lastly, managerial attitude toward change refers to how willing the management team is in allowing change to the internal processes of an organization. Since service innovation requires changes ranging from radical changes to the smallest change of improvement innovation, we posit that managerial attitude toward change positively affects service innovation. . Therefore, we hypothesize

Hypothesis 1: Internal driving forces (internal communication, absorptive capacity, R&D resources, and managerial attitude toward innovation) affect service innovations.

Service companies lead innovations through the internal interactions in an organization as well as external interactions. While studying external driving forces of small businesses, Romano (1990) found that competitive edge, market changes, product/market mix, and customer base are driving forces that influence product innovation in high-growth firms. In addition, Kaufmann and Todtling (2005) have studied new innovation by leveraging the knowledge to build capacity for innovation through customers and suppliers. Hence, an organization's external factors on innovation potential of the market were described as one of the success factors of innovation.

Another important factor is customer involvement and effective communications in the innovation process (Feldman and Page 1984). In a service-oriented model, the customer's participation has played a very important role so that organizations need to acquire knowledge of the market from the interactions with the existing customers (Gruner and Homburg 2000). In the innovation process, organizations develop better service models based on customer's needs. Thus, the emphasis on customer interaction in innovations is an important external factors, especially in the service industry.

Services companies increasingly emphasize the partnership between themselves and their business partners. (Howells 2000). Suppliers play a major role in creating innovations in the service industry. Acquired knowledge and information from the interaction between the customer, suppliers, and the company lead to innovations (Foss et al. 2011).

Because companies can increase corporate profits more quickly by responding to the changing market, market potential can be defined as the opportunity for companies to recognize the potential of the market (Kok et al. 2003). In this study, market potential refers to the ability to rise to the market of the future, or what customers want in order to meet the potential of the region or market opportunities.

According to Laursen and Salter (2006), successful innovation can be done through the knowledge and expertise from a wide range of external resources. Innovations can be obtained and sustained using external resources or actors (Chesbrough 2003). Hence, we hypothesize

Hypothesis 2: External driving forces (interaction with customers, market potential, and interaction with suppliers) affect service innovations.

METHODOLOGY

This study analyzes data from the leading providers of mobile communication services in South Korea. We chose this specific industry because we believe mobile communication companies can represent service-oriented companies in general. These mobile services providers supply customers with the ability to connect and

communicate over their network, which at its core is the definition of service. In order to explore the data and have a more in-depth analysis, we employ content analysis as a research method. Content analysis is one of the empirical research methods that use existing data analysis methods in order to ensure objectivity and reliability. The data used in the content analysis is from newspapers, magazines, electronic documents, editorials, speeches, official documents, television, and radio programs. This data is suitable for research purposes because content analysis allows us a systematic procedure to transform the meaning of the text (Weber, 1990; Krippendorff, 2004).

Data Sample

In 1996, Korea's mobile telecommunications industry started with 3 million digital mobile phone service subscribers. The industry achieved 20 million subscribers by the end of 1999, and reached 4,790 million subscribers by 2009. Every two to three years, the technologies and trends in the mobile communications market have changed rapidly; therefore, for the leading providers of mobile communication services, innovation is essential to the continued growth.

We analyzed the official press released of two Korea Mobile communications service providers (SK Telecom and KT). We collected data from November 29, 2009 (when the iPhone was released in South Korea), to November 27, 2011 which was approximately two years worth of data. Four hundred and seventy-two press releases from SK telecom and 768 press releases from KT associated with the mobile communication services were collected. Of these, one hundred twelve of 472 press releases from SK telecom and 166 of 768 press releases from KT were identified as related to mobile communications services innovation. This was determined by examining each press release for the service offering. If the press release discussed a service offering then kept and coded as a service innovation type. If the press release did not mention a service then the press release was discarded and not analyzed further. For example, a press release that discusses a twenty percent discount off loyalty members is not considered a service offering and would be dropped from further analysis.

Coding

The coding scheme that was used in this study is based on the individual press releases that were collected. Coding consisted of two steps. In the first step, we categorized each press release by the type of service innovation as defined by Gallouj and Weinstein (1997). If the contents of the press release were not related to innovation they were excluded from the analysis. In the second step of the coding process, we examined each sentence of the press release for the factors that influence or drive the service innovation. Factors affecting each of the samples were divided into seven-dimensional internal or external driving forces. We also checked reliability by examining stability, reproducibility, and accuracy (Krippendorff 2004). Furthermore, sample validity and semantic validity were also examined.

DATA ANALYSIS

Table 1 shows the frequencies of each driving force by the types of service innovation from both organizations.

Table 1. Frequencies of driving forces by innovation types							
	Types of Service Innovations						
Driving Forces	Radical	Improvement	Incremental	Ad-Hoc	Recombinative	Formalization	Total
Internal Communication	6	4	7	0	0	3	20
Absorptive Capacity	63	34	49	0	21	19	186
Research & Development	104	50	82	0	31	25	292
Managerial Attitude toward innovation,	12	10	15	1	4	24	66
Interaction with Customers	8	11	5	1	0	5	30
Interaction with Suppliers	37	8	13	0	5	6	69
Market Potential	6	0	2	0	1	10	19

Total for Internal Driving Forces	185	98	153	1	56	71	564
Total for External Driving Forces	51	19	20	1	6	21	118

As shown in Table 1, there are rare cases of driving forces associated with Ad-hoc service innovations so we exclude this case for further analysis. To examine the hypotheses, we employ multinomial logistic regression analysis. Table 2 shows the results from the analysis. The results show that seven forces affected service innovation types compared to the reference category of recombinative service innovation.

Table 2. Multinomial Logistic Regression Analysis				
Driving Forces	Radical Service Innovation	Improvement Service Innovation	Incremental Service Innovation	Formalization Service Innovation
Internal Communication	18.542 ^{***} (.000)	18.422 ^{***} (.000)	18.809 ^{***} (.000)	18.801 (-)
Absorptive Capacity	.010 (.976)	-.073 (.842)	-.001 (.999)	-.105 (.783)
R&D Resource	.114 (.615)	.001 (.997)	.196 (.401)	-.007 (.980)
Managerial Attitude Toward Innovation	-.007 (.991)	.358 (.583)	.524 (.392)	-.178 (.813)
Interaction with Customers	19.040 ^{***} (.000)	20.268 ^{***} (.000)	18.832 ^{***} (.000)	18.350 (-)
Interaction with Suppliers	1.005 [*] (.047)	-.022 (.971)	.243 (.659)	.860 (.126)
Market Potential	.544 (.618)	-19.458 (-)	-.255 (.836)	1.900 [*] (.075)
Intercept	.556 (.204)	.196 (.687)	.324 (.476)	-.171 (.736)

Notes: 1) Reference category for the equation is Recombinative Service Innovation.

2) *p < 0.05, **p < 0.01, ***p < 0.001

The regression equation (1) below is the radical innovation compared to the reference category of recombinative service innovation.

$$\log \left(\frac{\pi_{Rd}}{\pi_{Rc}} \right) = 0.556 + (18.542)IC + (0.010)AC + (0.114)R\&D + (-0.007)MA + (19.040)CI + (1.005)SI + (0.544)MP \quad (1)$$

where π_{Rd} = radical service innovation probability

π_{Rc} = recombination service innovation

IC = internal communications

AC= absorptive capacity

R&D = research and development

MA = managerial attitude toward change

CI=customer interaction

SI=interaction with suppliers

Compared to the recombinative service innovation, the driving forces that affected radical innovations are internal communication (IC), customer interaction (CI), interaction with supplier (SI). These forces are all statistically significant at $p < 0.05$.

The second column in Table 1 demonstrates the effectiveness of the seven independent variables on the possibility of improvement service innovation compared to the reference category of recombinative service innovation. In this case, interaction with customers and internal communication appears statistically significant at $p < 0.01$ level. Finally, only market potential becomes statistically significant at $p < 0.05$ for formalization service innovation compared to recombinative service innovation.

Based on the results of the multinomial logistic regression analysis, we were able to accept hypothesis 1 and hypothesis 2. Both internal driving forces (H1) and external driving forces (H2) affect different service innovation types.

DISCUSSION

According the multinomial logistic regression analysis, the different driving forces become significant across different types of service innovations. First, radical service innovation compared to the recombination service innovation is influenced by internal communication, interaction with customers, and interaction with suppliers. Second, internal communication and interaction with customers are significant determinants for improvement and incremental service innovations. For formalization service innovation, only market potential becomes a significant factor. Our results provide an insight when an organization tries to determine the factors influencing service innovations and suggests that organizations need to set up different strategic approaches depending on what service they want to innovate. Interestingly, several driving forces were not shown to be significant in the different innovation types. These appear to be contrary to the general service innovation literature. We speculate two reasons for this phenomenon. First, we examined only two firms in a single Asian country. The cultural forces at play could influence the managerial attitudes' and the interaction with suppliers. Second, and more importantly, we used Gallouj and Weinstein (1997) service innovation classifications. These six different types have never been examined using innovation driving forces. It could be the case where driving forces are significant under the general headings of radical and incremental innovations, but since we further classified the innovations, we may have lost significance. Further research is warranted in this area.

The results of our study can help companies focus their capital and energy on specific driving forces which could lead to different innovation types. For example, if a company is trying to promote a radical service innovation then the company should focus their initial efforts on internal communications, interaction with customers, and interaction with suppliers. Contrary to previous studies, our findings did not conclude that research and development resources were critical in affecting any service innovation type. Further research needs to be undertaken to understand this anomaly compared to other research. This could be due to the specific country or industry that was studied which is discussed further in the next section.

REFERENCES

- Brentani, U. "Innovative versus incremental new business services: different keys for achieving success," *Journal of Product Innovation Management* (18:3) 2001, pp 169-187.
- Brown, S. L., and Eisenhardt, K. M. "The Art of Continuous Change: Linking Complexity Theory and Time-Paced Evolution in Relentlessly Shifting Organizations," *Administrative Science Quarterly* (42:1) 1997, pp 1-34.
- Chandy, R. K., and Tellis, G. J. "Organizing for Radical Product Innovation: The Overlooked Role of Willingness to Cannibalize," *Journal of Marketing Research* (35:4) 1998, pp 474-487.
- Chesbrough, H.(2003). "Open Innovation" *Harvard University Press*: Cambridge, MA
- Chesbrough, H., and Spohrer, J. "A research manifesto for services science," *Communications of the ACM* (49:7) 2006, pp 35-40.
- Cohen, W., & Levinthal, D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128-152.
- Cummings, T. G., and S. Srivastva. "Management of Work: A Socio-Technical Systems Approach" Kent, Ohio: The Comparative Administration Research Institute of Kent State University, 1977.

- Daft, R. L. "Bureaucratic versus nonbureaucratic structure and the process of innovation and change," *Research in the Sociology of Organizations* (1) 1982, pp 129-166.
- Damanpour, F. "Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators," *The Academy of Management Journal* (34:3) 1991, pp 555-590.
- Damanpour, F., and Evan, W. M. "Organizational innovation and performance: the problem of" organizational lag", *Administrative Science Quarterly* 1984, pp 392-409.
- Den Hertog, P.(2000). "Knowledge-intensive business services as co-producers of innovation" *International Journal of Innovation Management* Vol.4 No.4 pp.491-528.
- Dewar, R. D., and Dutton, J. E. "The Adoption of Radical and Incremental Innovations: An Empirical Analysis," *Management Science* (32:11) 1986, pp 1422-1433.
- Downs Jr, G. W., and Mohr, L. B. "Conceptual issues in the study of innovation," *Administrative Science Quarterly* 1976, pp 700-714.
- Feldman, L.P. and Page, A.L.(1984). "Principles versus practice in new product planning" *Journal of Product Innovation Management* (January) pp.43-55.
- Foss, N.J., Laursen, K. and Pedersen, T.(2011). "Linking Customer Interaction and Innovation" *Organization Science* Vol.22 No.4 pp.980-999.
- Galloway, F., and Weinstein, O. "Innovation in services," *Research policy* (26:4-5) 1997, pp 537-556.
- Gruner, K.E. and Homburg, C.(2000). "Does customer interaction enhance new product success?" *Journal of Business Research* Vol.49 No.1 pp.1-14.
- Hage, J. *Theories of Organizations* Wiley, New York, 1980.
- Howells, J. "Innovation & Services: New Conceptual Frameworks" CRIC Discussion Paper (38) 2000, 1-29
- Kaluzny, A., J. Veney, and Gentr, J..(1974). "Innovation of Health Services: A Comparative Study of Hospitals and Health Departments" *Health and Society* (Winter)
- Katila, R., and Ahuja, G. "Something Old, Something New: A Longitudinal Study of Search Behavior and New Product Introduction," *The Academy of Management Journal* (45:6) 2002, pp 1183-1194.
- Kaufmann A., Tödtling F.(2001). "Science-industry interaction in the process of innovation: the importance of boundary-crossing between systems." *Research Policy* Vol.30 pp.791-804.
- Knight, K. E. "A descriptive model of the intra-firm innovation process," *The Journal of Business* (40:4) 1967, pp 478-496.
- Kok, R.A.W., Hillebrand, B. and Biemans, W.G.(2003). "What makes product development market oriented? Towards a conceptual framework" *International Journal of Innovation Management* Vol.7 No.2 pp.137-63.
- Krippendorff, K.(2004) "Content Analysis" SAGE Publication Second Edition.
- Laursen, K and Salter, A. J "Open for innovation: The role of openness in explaining innovative performance among UK manufacturing firms." *Strategic Management Journal* (27: 2)2006, 131-150
- Lawrence, Stacy (Producer). (2004, 12/5/10). FDA Approves Surgical RFID Tag. Retrieved from <http://www.eweek.com/c/a/Health-Care-IT/FDA-Approves-Surgical-RFID-Tag/>
- Lewin, Arie Y. (1999). Application of Complexity Theory to Organization Science. *Organization Science*, 10(3), 215-215.
- Love, J. H., and Roper, S.(2009). "Organizing innovation: Complementarities between cross-functional teams." *Technovation* Vol.29 No.3 pp.192-203.
- Matthing, J., Sande'n, B. and Edvardsson, B.(2004). "New service development: learning from and with customers." *International Journal of Service Industry Management* Vol.15 No.5 pp.479-49.
- Nonaka, I., and Takeuchi, H.(1995). "The knowledge-creating company: How Japanese companies create the dynamics of innovation." New York: Oxford Press
- Oke, A. "Innovation types and innovation management practices in service companies," *International Journal of Operations & Production Management* (27:6) 2007, pp 564-587.
- Rogers, E. M., and Shoemaker, F. F. *Communication of Innovation* The Free Press, New York, 1971.
- Romano, C. A. "Identifying Factors Which Influence Product Innovation: A Case Study Approach," *Journal of Management Studies* (27:1) 1990, pp 75-95.
- Rowe, L. A., and Boise, W. B. "Organizational innovation: Current research and evolving concepts," *Public Administration Review* (34:3) 1974, pp 284-293.

- Saviotti, P. P., and Metcalfe, J. S. "A theoretical approach to the construction of technological output indicators," *Research Policy* (13:3) 1984, pp 141-151.
- Sundbo, J. "Management of innovation in services," *Service Industries Journal* (17:3) 1997, pp 432-455.
- Tarafdar, M., and Gordon, S. R. "Understanding the influence of information systems competencies on process innovation: A resource-based view," *The Journal of Strategic Information Systems* (16:4) 2007, pp 353-392.
- Tellis, G. J., Prabhu, J. C., and Chandy, R. K. "Radical Innovation Across Nations: The Preeminence of Corporate Culture," *Journal of Marketing* (73:1), 2009/01/01 2008, pp 3-23.
- Thomson Reuters "Top 100 Global Innovators: Honoring the World Leaders in Innovation."